

Why Does Soil Matter?

Soil matters because *it is made of matter*. Soil is made up of organic matter, minerals, water, air, and countless organisms. The soil beneath our feet is as important as the air we breathe and the water we drink. It is the primary source of food, feed, fuel, forage, and fiber. Life on Earth, as we know it, depends on soil.

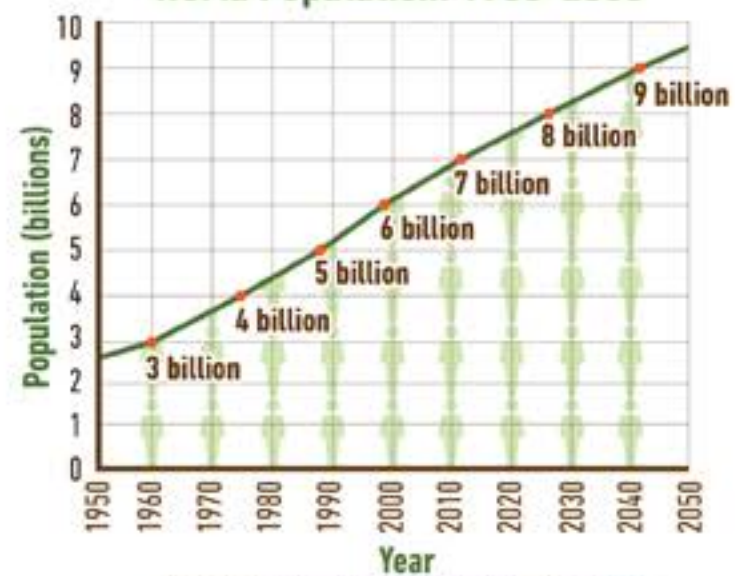
LIFE Depends on Soil

In the time it takes you to read this paragraph, the world population will have increased by 100 people. There are more people on Earth now than ever before and the number continues to climb. By 2050, the world's population is expected to reach 9.8 billion people. More people will require places to live, work, and move about, so the amount of soil available to grow food will decrease.

How are we able to grow enough food for everyone? Agriculture is the answer. Farmers care for the land and reintroduce important elements to the soil. This will help them grow more food on the same amount of land.

Use the graph to determine how many more people will live on Earth in 2050 than today.

World Population: 1950-2050

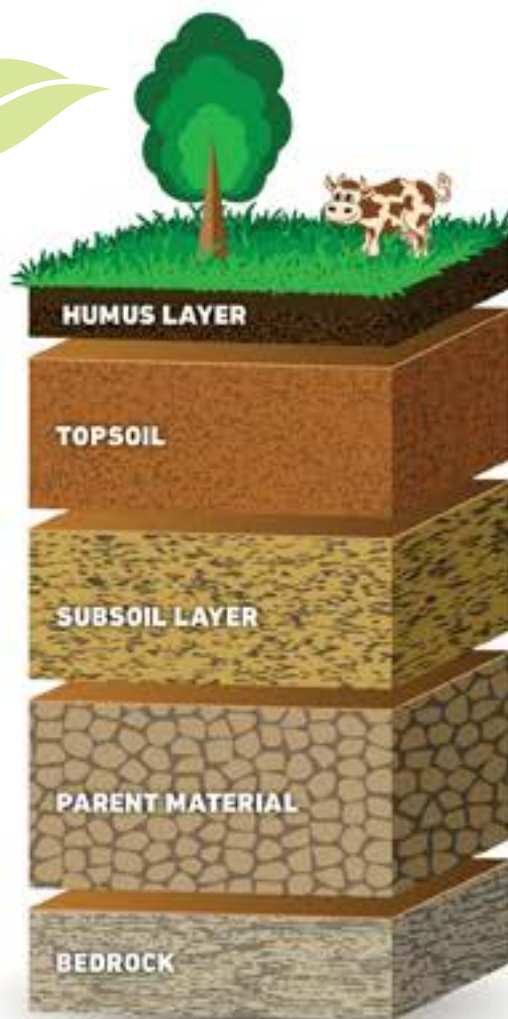


Source: U.S. Census Bureau, International Data Base, July 2015 Update.

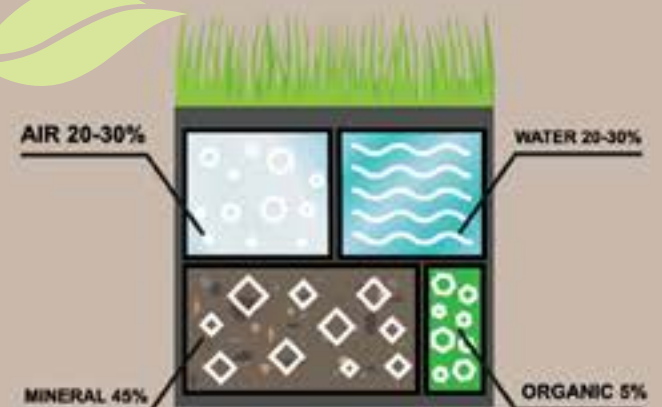
Soil Layers

Below our feet, the materials of the earth create distinct layers we call horizons.

- Humus Layer** – The surface on which we walk and live. This layer is comprised of living organic matter like grass, trees, and other plants, as well as partially decomposing matter like fallen leaves.
- Topsoil** – This is where plant roots take hold. Wind or water erosion can wash away this valuable layer if farmers, greenskeepers, construction workers and others do not protect it. Most nutrients, organisms, and roots are in this layer. It is comprised of sand, silt, clay, and organic matter.
- Subsoil Layer** – This layer is about one foot below the surface where deeper tree roots and earthworms are usually found. Like topsoil, subsoil is comprised of sand, silt, and clay, but with significantly less organic material.
- Parent Material** – Existing about three feet below the surface, it is more compact and rockier than the layers above it.
- Bedrock** – A layer of hard rock.



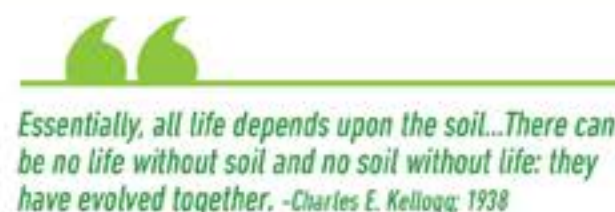
Science of Soil



SOIL IS ALIVE!

Say it with Soil

People have been talking about soil since the dawn of time. Dig in to some of these quotes. What do you know about the people who said them? How can you add to the conversation?



Who is Responsible for Soil Conservation?

Soil conservation is the protection and careful use of soil to prevent it from being lost or damaged. Soil conservation is important because soil can be damaged easily, but it cannot be replaced easily. It takes hundreds of years to replace one inch of top soil. In Illinois, most of our soil loss is caused by water erosion. Farmers play a big role in soil conservation. You, too, can help conserve soil.

CONSERVATION TILLAGE

Farmers use conservation tillage, such as no-till and strip-till. These methods leave the previous year's crop residue, such as corn stalks or soybean stubble, on the fields after harvest to protect soil over the winter when nothing is growing.

COVER CROPS

Farmers plant cover crops after harvest. Cover crops can add nutrients back into the soil and "cover" the soil – protecting it from wind and water erosion.

CONTOUR FARMING

Instead of planting crops in rows of straight lines, farmers plant rows which follow the natural shapes of the land to slow water runoff and reduce erosion.

CROP ROTATION

Farmers rotate crops. This practice, called crop rotation, is when farmers grow different types of crops in the same area in sequential seasons. It helps ensure that the soil is not depleted of certain nutrients. It also helps reduce soil erosion and increase soil fertility and crop yield.

BUFFERS

Farmers use strips of permanent vegetation, called buffers, to intercept nutrients and sediment carried by surface water. Buffers slow down surface water, allowing plants to absorb and use the water and nutrients.

TECHNOLOGY

Farmers use technology, such as global positioning systems (GPS) to see pictures, or soil maps, of the land to spot and address erosion.

Farmers:



You:



COVER SOIL

Cover bare soil with new plants or mulch. Soil coverings, like mulch, help keep soil in place.

PLANT VEGETATION

Plant trees, shrubs, bushes, flowers and other forms of vegetation. Plant roots help prevent soil erosion.

USE WALKWAYS

Stay on sidewalks, trails, and other walkways. When you walk where it is designated, you protect soil by not carrying it away on your shoes and clothes.

REDUCE, REUSE & RECYCLE

Practicing the 3 Rs (reduce, reuse & recycle) every day is important for healthy soil, as well as a healthy environment.

MANAGE WASTE

Follow guidelines when disposing of contaminants like paint. Waste can hurt the soil as well as human, plant, and animal health.

INFORM FRIENDS

Tell others how important soil is for survival and encourage them to protect soil. More people protecting soil will help make sure it stays in place and stays healthy for future generations.

Scientists have found more than 75,000 different types of soil in the United States alone.

SOIL TYPES

Farmers often turn to agronomists to learn more about the soil on their land, and how it may impact a growing season. Farmers need to know about their soil to ensure their crops have enough nutrients available. The make-up of the soil also gives farmers clues about how the land will hold or drain water.

There are many different types of soil and each is made up of a different mix of three components: sand, silt, and clay. To picture

the scale of these components think of clay as the size of a pea, silt as the size of a grapefruit, and sand the size of a pumpkin. The ideal soil is a mixture of peas, grapefruits, and pumpkins, or clay, silt and sand. This mixture provides small spaces to hold water and air, as well as larger spaces to drain excess moisture away. Illinois alone has over 700 different soil types.

FUN FACT: The Illinois State Soil is "Drummer silty clay loam"

Sand is the largest particle size among soil types, and it is dry and gritty to the touch. It does not hold water as well as other soil types.

Silt is a medium particle size. When moistened, it is slick. It compacts easily and retains water longer than sand.

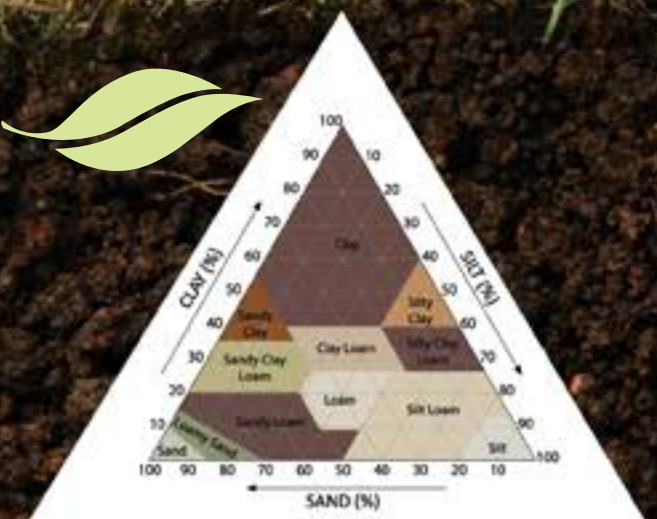
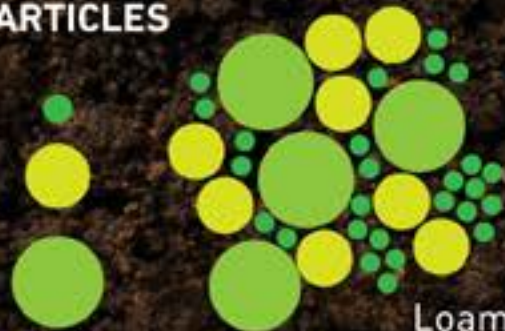
Clay is the smallest particle size of the three soil types. It is sticky to touch when wet, smooth when dry. It retains water longer than sand or silt.

SOIL PARTICLES

Clay

Silt

Sand



VOCABULARY

AGRONOMIST: A professional who studies soil and crop management.

CONSERVATION: Protection of natural resources.

CROP RESIDUE: Materials left in an agricultural field after the crop has been harvested. These residues include stalks, stubble, seeds, and roots.

EROSION: The process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.

LOAM: Soil made up of mostly sand and silt.

MICROORGANISMS: Things like bacteria, fungi, worms, and insects that live in soil.

ORGANIC MATTER: Matter composed of organic compounds that have come from the remains of organisms such as plants and animals and their waste products in the environment.

SOIL FERTILITY: The ability to sustain plant growth. A fertile soil is rich in nutrients necessary for basic plant nutrition, including nitrogen, phosphorus, and potassium.

TILLAGE: The preparation of land for growing crops.



Soil Gives Plants NUTRIENTS...

Like us, plants need nutrients to grow. Plants get nutrients from the soil. The nutrients in the soil can become depleted when we grow lots of plants year after year. Farmers are careful to put those nutrients back into the soil. Farmers and agronomists prescribe nutrients for their soil and crops, similar to doctors prescribing vitamins for their patients. Three of the main nutrients plants need are nitrogen (N), phosphorus (P), and potassium (K).

Nitrogen – Nitrogen is found in the air and soil. Most crops use nitrogen rapidly, but they cannot get it straight from the air. Nitrogen is incorporated into the soil through the nitrogen cycle. In this cycle, nitrogen passes from the air to the soil, to plants, and then returns to the air or soil through plant decay.

Phosphorus – Phosphorus helps plants catch the sun's energy and grow. Additionally, it helps store and transfer energy during photosynthesis. Phosphorus is in the soil, but not in a form that can be immediately absorbed by plants. Farmers commonly apply phosphorus to the soil.

Potassium – All plants require potassium for growth and reproduction. It is often referred to as "the regulator" because it is involved in the activation and regulation of numerous plant processes. When soil is lacking potassium, plants cannot grow as they should. Farmers apply potassium fertilizer to soil to help plants grow to their fullest potential.

...and we can give soil nutrients

Farmers supply nitrogen to plants in a variety of ways. By application of nutrients to the soil, by applying composts and manures, and by growing legumes in rotation with other crops.

4R Nutrient Stewardship helps farmers consider the best practices when applying nutrients or fertilizer. It asks farmers to think about the right source, right rate, right time, and right place for application. The 4Rs work to increase production and profitability for farmers while ensuring the best care for the land and water.

4R NUTRIENT STEWARDSHIP



RIGHT SOURCE

Many types of nutrients are available. It is important to select the right nutrients for the plant's needs.



RIGHT RATE

It is important to match the right amount of nutrients to a plant's needs. Too little limits the plants growth and too much is wasteful.



RIGHT TIME

It is important to apply nutrients at the right time for healthy plant growth. A plant needs access to different nutrients in the soil at different times as it grows.



RIGHT PLACE

Plants need nutrients located in the right place within reach of the plant's roots. Tractors help farmers place nutrients in the right place.

The "Dirt" on Soil

Dirt is slang for misplaced soil. When we call soil 'dirt', we are usually referring to something we wash off our hands. Dirt is soil that is out of place in our world - whether tracked inside by our shoes or on our clothes. Dirt is soil that has lost the characteristics that give it the ability to support life.

Just one acre of cropland is home to more than **1,400,000 EARTHWORMS.**



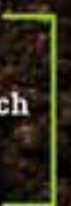
NUTRIENT FACTS

THE NUTRIENTS SOIL PASSES ON TO PLANTS ARE GOOD FOR US TOO.

NUTRIENT	FOR PLANTS	FOR US
Nitrogen (N)	Leaf, stem, and root growth. Green color (chlorophyll).	Proteins and amino acids essential for all our cells.
Phosphorus (P)	Flowers, fruits, and seeds	Helps brain and nerves work.
Potassium (K)	Water uptake. Improves resistance to pests and disease.	Healthy muscles and blood circulation.

It takes between 200 to 500 years to make one inch of topsoil.

1 inch



FROM SOIL TO STORE

The life essentials that come from soil (food, feed, fuel, forage, and fiber) have a long journey from where they start in the soil to making their way to the store for us to purchase. Follow along to see a green bean's journey from the soil to the store. What soil to store examples can you think of?

GREEN BEANS: FROM FARM TO TABLE

1. Green beans are grown on a farm where farmers work hard to maintain healthy soil. Mason County is the top green bean producing county in Illinois. Farmers apply nutrients to the soil. Farmers use scientific tools to determine the right amount and the right combination of nutrients to apply to the soil.
2. Farmers plant green bean seeds in the soil. These seeds need to grow into a plant. The plant needs water, air, sunlight, and nutrients to grow.



3. The plant takes time to grow. It takes 50-55 days for the plant to produce green beans.
4. The farmer then harvests the green beans. They are either shipped to the store or to a processing plant.
5. At a processing plant, like the Del Monte Processing Plant in Mendota, Illinois, the beans are boiled and placed in a can with a small amount of canning salt. <https://www.delmontefoods.com>



6. At the store you can buy fresh or canned green beans, depending on the season. Remember, it all started with the soil beneath your feet!

A Slice of Soil



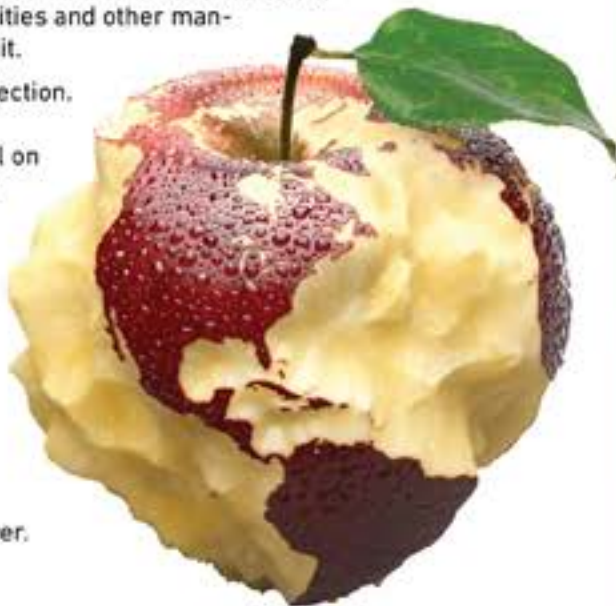
MATERIALS NEEDED:

Apple, Paring Knife, Cutting Board

ACTIVITY INSTRUCTIONS:

Soil is one of our most important natural resources on the earth's surface. Many living things depend on it for food. People do, too. Not all soil is good enough for plants to grow. Complete this activity to learn just how little soil we have to grow food.

1. Cut an apple into four equal parts. Three parts represent the oceans of the world. The fourth part represents the land area.
2. Cut the land section in half lengthwise. Now you have two 1/8 pieces. One section represents land such as deserts, swamps, Antarctic, Arctic, and mountain regions. The other 1/8 section represents land where man can live and may or may not be able to grow food.
3. Slice this 1/8 section crosswise into four equal parts. Three of these 1/32 sections represent the areas of the world that are too rocky, too wet, too hot, or where soils are too poor to grow food. Plus, we can't grow food on some land because cities and other man-made structures are built on it.
4. Carefully peel the last 1/32 section. The peel on this small piece represents the amount of soil on which we have to grow food. This amount of soil will never get any bigger.



EXTENDED RESPONSE: Why is soil so important? Think about its impact on agriculture and the foods you eat. Be sure to include your own experiences along with information from the Soil Ag Mag to support your answer.

CAREERS



EVAN HULTINE
Hultine Farms, Bureau County, IL

Evan uses filter strips, leaving grass untouched along the waterways on his land, to help prevent soil and water from his farm from entering the water.

"When we have a big rain, these best practices do the job of controlling surface water runoff and help with erosion control. In my corn fields we use split-applied nitrogen while utilizing the 4R nutrient plan, which helps the environment by keeping our nutrients on our farm instead of in our water sources.

Read more about the 4Rs on page 3.



RONALD D. COLLMAN
State Soil Scientist, USDA NRCS

Describe how you became interested in working with soil.

"From an early age, I was always interested in rocks, fossils and the natural sciences. I had a section of the garden set aside for me to plant what I wanted. I did not understand so much depends on the soil. I learned our food comes from the plants that grow in the soil, our homes are built on the soil, many of our building materials come from the soil, much of our clothing come from plants and animals that are tied to the soil, and the list goes on. If we don't take care of our soil, it will no longer be able to provide the plants and animals needed for the population to sustain itself. Soil science ties together many natural, physical and chemical sciences to bring an understanding to the complex nature of soil and the soil ecosystem. My job has variation, including field work, lab work and computer work. The knowledge I gain and share with other others leads to the intelligent use of one of our most important resources."

What are the major factors that farmers and homeowners will have to consider with the nutrient management plan?

"We want farmers and landowners to use the land in a sustainable way so future generations will have the same, or better opportunities to use the land to live on and also produce food. A successful nutrient management plan helps farmers reduce the amount of nutrients a farmer needs to add to a field to maintain expected yield while also reducing the amount of nutrient loss through infiltration and runoff. Specific site tests give us more knowledge to allow us to make good management decisions in order to reach the goals we have in mind. Farmers want to produce as much as the soil will allow under current conditions, and to maintain that productivity over time."

How can students become more involved with soil?

"Soil is all around us. It touches so many parts of our lives. Start by becoming educated on the soil in your area. Dig a small hole and start identifying all the things you find in just one shovelful of soil—it just might amaze you!"



THE METCALF FAMILY
Edwards County

The Metcalfs worked hard, making changes and updates to the way their land was farmed. Their goal was to create a plot of land that would hold together and could be farmed sustainably.

"On this 40 acre field, we terraced the top 27 acres and included 17 riser pipes. Severe erosion was making the field non-farmable. These conservation methods (terraces and riser pipes) will hold the soil together, while preventing erosion and nutrient run-off. The farm will now be no-tilled, while also using cover crops."

Read more stories of farmer conservation work at www.heartlandgisweb.com/Illinois_CBM.

One tablespoon of healthy soil has more organisms in it than there are people on Earth.



This Ag Mag complements and can be connected to the following Common Core, Next Generation Science Standards, and Illinois Learning Standards for Social Science.

Common Core State Standards: CCSS.ELA-Literacy: RI.3.5; RI.4.1; RI.4.2; RI.4.7; RI.4.10; RF.4.4; RF.4.4.A; SL.4.1; SL.4.1.B

Math Content: 3.NF.A.1; 3.G.A.2; 4.NBT.A.2; 4.NBT.A.3; 4.NBT.B.4; 4.NF.A.2; 5.G.A.1; 5.G.A.2

Next Generation Science Standards: 3-LS4-3; 3-LS4-4; 3-LS1-1; 3-LS3-2; 3-ESS3-1; 4-ESS2-1; 4-ESS3-2; 5-ESS3-1

Illinois Learning Standards for Social Science: SS.IS.1.3-5; SS.IS.7.3-5; SS.G.2.4; SS.EC.2.4

This issue of Ag Mag has been provided by: Compeer Financial.



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